SECTION I.—AEROLOGY.

SOLAR AND SKY RADIATION MEASUREMENTS DURING APRIL, 1916.

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For a description of instrumental exposures, and an account of the methods of obtaining and reducing the measurements, the reader is referred to the REVIEW for January, 1916, 44:2.

The monthly means and departures from normal values given in Table 1, show that direct solar radiation intensities were generally below normal at Washington, and above normal at Madison and Santa Fe. A noon maximum intensity of 1.64 gram-calories per minute per square centimeter, measured at Santa Fe on the 8th, exceeds by 4 per cent any previous April noon measurement at that station, and nearly equals the station maximum for the year.

At Washington on the morning of the 10th, at Madison on the morning of the 6th and the afternoon of the 14th, at Lincoln on the morning of the 1st, and at Santa Fe on the mornings of the 20th and 21st, the measurements indicate steady sky conditions throughout most of the respective half-day periods. Extrapolating to zero air mass and reducing to mean solar distance of the earth, the measurements give radiation intensities of 1.78, 1.79, 1.78, 1.80, 1.81, and 1.81 gram-calories per minute per square centimeter, respectively. Allowing for the probable differences in the water-vapor content of the atmosphere at the several stations, due not only to their differences in elevation above sea level, but also to the differences in the surface vapor pressure, as shown in Table 2, the above determinations are in close agreement. Applying the Smithsonian "Abridged procedure for determining approximately the value of the solar constant" [1] to the Santa Fe measurements of April 20 and 21, we obtain 1.90 gram-calories, or a little less than Abbot's mean value of the solar constant.

TABLE 1.—*Solar radiation intensities during April, 1916.*

[Gram-calories per minute per square centimeter of normal surface.]

Santa Fe, N. Mex.

Date.	Sun's zenith distance.									
	0.0°	48.3°	60.0°	66.5°	70.7°	73.6°	75.7°	77.4°	78.7°	79.8°
	Air mass.									
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
A. M.	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*
Apr. 1	.....	.....	1.39	1.33	1.26	.....	1.17	1.10	.....	.....
6	1.59	1.51	1.41	.....	.....	.....	.....	.....	.....	.....
7	1.60	1.55	1.47	1.34	1.31	1.27	1.22	1.17	1.12	.....
8	1.67	1.45	1.38	1.29	1.25	1.18	1.08	0.97	0.88	.....
13	1.62	1.50	1.36	1.26	1.18	1.14	.....	.....	.....	.....
18	.....	1.42	1.32	1.23	.....	1.12	1.05	.....	.....	.....
20	1.61	1.56	1.45	1.38	1.32	1.27	1.20	1.05	.....	.....
21	1.61	1.52	1.44	1.38	1.31	1.25	1.17	.....	.....	.....
Monthly means	1.62	1.50	1.40	1.32	1.27	1.20	1.15	1.07	(1.00)	.....
Departure from 4-year normal	+0.06	+0.06	+0.02	+0.05	+0.06	+0.02	±0.00	±0.00	±0.00	.....

[1] Annals of the Astrophysical Observatory of the Smithsonian Institution, Washington, 1908, 2:115.

TABLE 1.—*Solar radiation intensities during April, 1916*—Continued.

Washington, D. C.

Date.	Sun's zenith distance.									
	0.0°	47.3°	60.0°	66.5°	70.7°	73.6°	75.7°	77.4°	78.7°	79.8°
	Air mass.									
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
A. M.	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*
Apr. 7	.....	1.32	1.26	1.21	1.12	1.06	1.00	0.97	.....	.....
10	1.44	1.31	1.17	1.05	0.97	0.90	0.82	0.73	0.65	0.62
11	1.33	1.20	1.12	1.00	0.89	0.81	0.74	0.68	0.64	0.60
12	1.28	1.22	1.11	1.04	0.97	0.88	0.79	0.73	0.68	0.63
15	.....	.....	.....	.....	.....	.....	1.01	0.95	0.90	.....
18	.....	1.32	1.22	1.13	1.04	0.95	0.87	0.80	.....	0.67
19	.....	1.13	1.07	0.91	0.78	0.69	0.61	0.55	0.47	0.40
20	1.02	.....	.....	.....	.....	.....	.....	.....	.....	.....
24	.....	.....	0.97	0.84	0.75	0.68	0.61	0.55	.....	.....
26	.....	1.00	0.84	0.74	0.67	0.57	0.50	0.45	.....	.....
29	.....	0.96	0.76	0.67	0.57	0.47	.....	.....	.....	.....
30	.....	1.16	1.06	0.94	0.83	.....	.....	.....	.....	.....
Monthly means	1.27	1.18	1.06	0.95	0.86	0.78	0.77	0.71	0.67	0.58
Departure from 8-year normal	−0.11	±0.00	−0.01	−0.03	−0.05	−0.06	+0.03	−0.03	−0.03	−0.06
P. M.										
Apr. 5	.....	1.05	.....	.....	.....	.....	.....	.....	.....	.....
10	.....	1.22	1.14	1.05	0.95	0.86	0.80	0.74	0.68	.....
15	.....	.....	.....	1.13	0.99	.....	.....	.....	.....	.....
Monthly means	.....	(1.14)	(1.14)	(1.09)	(0.97)	(0.86)	(0.80)	(0.74)	(0.68)	.....
Departure from 8-year normal	.....	−0.05	+0.08	+0.10	+0.06	−0.02	+0.06	+0.13	+0.13	.....

Madison, Wis.

A. M.										
Apr. 1	.....	1.43	1.36	1.27	1.18	1.11	.....	.....	.....	.....
6	1.58	1.49	1.40	.....	.....	1.18	1.13	.....	.....	.....
10	.....	1.20	.....	.....	.....	.....	.....	.....	.....	.....
11	1.53	1.40	.....	.....	.....	.....	.....	.....	.....	.....
14	1.51	1.40	.....	.....	.....	.....	.....	.....	.....	.....
17	.....	.....	1.36	1.28	1.20	.....	.....	.....	.....	.....
27	1.47	1.37	1.28	1.19	1.11	.....	.....	.....	.....	.....
28	.....	1.32	.....	.....	.....	.....	.....	.....	.....	.....
Monthly means	1.52	1.36	1.35	1.25	1.16	(1.14)	(1.13)	.....	.....	.....
Departure from 6-year normal	+0.10	+0.04	+0.13	+0.12	+0.06	+0.02	±0.00	.....	.....	.....
P. M.										
Apr. 6	.....	1.49	.....	.....	.....	.....	.....	.....	.....	.....
9	.....	1.48	.....	.....	.....	.....	.....	.....	.....	.....
14	.....	1.40	1.29	1.19	1.11	1.05	0.99	.....	.....	.....
27	.....	1.35	1.22	.....	.....	.....	.....	.....	.....	.....
Monthly means	.....	1.43	(1.26)	(1.19)	(1.11)	(1.05)	(0.99)	.....	.....	.....
Departure from 6-year normal	.....	+0.07	−0.01	±0.00	±0.00	−0.04	±0.00	.....	.....	.....

Lincoln, Nebr.

A. M.										
Apr. 1	.....	1.48	1.39	1.30	1.22	1.12	.....	1.01	.....	.....
9	.....	.....	.....	.....	1.14	.....	.....	.....	.....	.....
10	.....	1.34	1.23	.....	.....	.....	.....	.....	.....	.....
11	.....	.....	.....	1.04	0.99	0.94	.....	.....	.....	.....
19	.....	.....	1.10	1.01	0.94	0.87	.....	.....	.....	.....
21	.....	1.43	1.30	.....	.....	.....	.....	.....	.....	.....
24	.....	.....	.....	1.20	.....	.....	.....	.....	.....	.....
28	.....	1.34	1.25	.....	.....	.....	.....	.....	.....	.....
Monthly means	.....	1.40	1.25	1.14	1.07	0.98	.....	(1.01)	.....	.....
P. M.										
Apr. 11	1.42	1.30	.....	.....	.....	.....	.....	.....	.....	.....
12	.....	1.28	.....	.....	.....	.....	.....	.....	.....	.....
16	.....	1.25	1.08	0.96	0.87	0.79	0.73	.....	0.61	.....
21	.....	.....	.....	1.15	1.06	0.99	0.93	0.86	0.78	.....
23	.....	.....	1.21	.....	.....	.....	.....	.....	.....	.....
24	.....	1.30	1.18	1.07	0.99	0.94	0.88	0.82	0.75	0.70
Monthly means	(1.42)	1.28	1.16	1.06	0.97	0.91	0.85	(0.84)	0.71	(0.70)

Skylight polarization measurements made at Washington on six days give a mean of 52 per cent, with a maximum of 58 per cent on the 11th and 12th. A higher maximum would undoubtedly have been obtained had not the ground been covered with snow on the morning of the 10th.

TABLE 2.—*Vapor pressure at pyrheliometric stations on days when solar radiation intensities were measured.*

Washington, D. C.			Madison, Wis.			Lincoln, Nebr.			Santa Fe, N. Mex.		
Date.	8 a. m.	8 p. m.	Date.	8 a. m.	8 p. m.	Date.	8 a. m.	8 p. m.	Date.	8 a. m.	8 p. m.
1916.	*Mm.*	*Mm.*	1916	*Mm.*	*Mm.*	1916	*Mm.*	*Mm.*	1916	*Mm.*	*Mm.*
Apr. 5	6.02	4.95	Apr. 1	4.57	4.95	Apr. 1	3.99	3.81	Apr. 1	2.87	3.63
7	3.15	3.99	6	1.78	2.87	9	2.74	3.99	7	1.88	1.52
10	3.63	3.99	9	2.06	2.06	10	4.57	5.56	8	2.49	2.62
11	4.75	5.56	10	3.81	5.56	11	6.50	7.04	13	3.45	3.81
12	5.36	4.95	11	6.27	3.15	12	11.81	5.16	18	3.63	3.45
15	3.81	3.99	14	4.37	3.81	16	7.04	4.17	20	2.36	1.52
18	3.63	3.81	17	3.81	3.00	19	10.21	9.47	21	2.26	3.30
19	4.17	3.99	27	4.17	4.57	21	5.16	5.56			
20	6.27	8.48	28	5.56	6.50	23	6.27	5.79			
24	5.56	6.27				24	6.02	3.63			
26	6.02	8.48				28	5.36	5.16			
29	7.87	6.76									
30	6.76	6.76									

In Table 3 are included for the first time the daily totals of radiation for Madison, Wis., and Lincoln, Nebr., as measured by a Callendar pyrheliometer. The measurements made at Madison during the five years ending with March 31, 1916, will be found summarized on pages 180 to 181 of this number of the REVIEW. The daily means for Madison from which the daily departures are computed include the measurements for the current month, and are therefore 6-year means.

The Callendar register was installed at the State university farm, Lincoln, Nebr., on June 30, 1915; therefore, daily means for Lincoln are not yet available. The receiver, No. 9861, is exposed on a small platform about 6 feet above the ridgepole of the experiment station building, 65 feet above the ground, and 1,250 feet, or 381 meters, above sea level. There are practically no obstructions between it and the sky in any direction down to the true horizon.

The receiver was first compared with a Marvin pyrheliometer at Mount Weather, Va., in 1913.[2] After its installation at Lincoln it was further compared with the Marvin pyrheliometer at that station. Care is also exercised to keep the instrument oriented so that the edges of the mica plates supporting the resistance grids are either at right angles to or in the same vertical plane of the platinum wires constituting the bright resistance grid [4]; so that for different degrees of cloudiness the value in heat units of the 0.1 inch ruled spaces on the record sheet is as shown below (Table 4.)

As shown by Table 3, the total radiation averaged below normal during the first and third decades of April at Washington, and during the second and third decades at Madison. At Lincoln it averaged below the Madison normals during the second and third decades, although generally, during the time the register has been in operation there, the decade means have been higher than the Madison normals.

At Washington the deficiency in radiation for the month was 9.7 per cent of the normal radiation for April,

TABLE 3.—*Daily totals and departures of solar and sky radiation during April, 1916.*

[Gram-calories per square centimeter of horizontal surface.]

Day of month.	Daily totals.			Departures from normal.		Excess or deficiency since first of month.	
	Washington.	Madison.	Lincoln.	Washington.	Madison.	Washington.	Madison.
1916.	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*
Apr. 1	502	575	596	120	191	120	191
2	292	567	408	− 92	180	28	371
3	108	422	170	−278	33	− 250	404
4	120	426	501	−268	34	− 518	438
5	417	519	520	27	125	− 491	563
6	304	639	309	− 89	242	− 580	805
7	465	261	238	70	−138	− 510	667
8	78	589	375	−320	187	− 830	854
9	260	631	553	−141	227	− 971	1,081
10	571	552	514	168	145	− 803	1,226
11	554	498	594	148	88	− 655	1,314
12	575	220	559	166	−192	− 489	1,122
13	342	338	179	− 70	− 77	− 559	1,045
14	313	634	520	−102	217	− 661	1,262
15	603	430	111	185	10	− 476	1,272
16	557	215	504	135	−207	− 341	1,065
17	323	682	307	−104	257	− 445	1,322
18	578	310	363	147	−117	− 298	1,205
19	541	310	384	105	−120	− 193	1,085
20	529	374	76	89	− 58	− 104	1,027
Decade departure						699	−199
21	450	109	701	5	−326	− 99	701
22	290	187	656	−159	−250	− 258	451
23	158	309	362	−296	−131	− 554	320
24	424	560	676	− 34	118	− 588	438
25	82	345	416	−380	−100	− 968	338
26	442	160	207	− 23	−287	− 991	51
27	378	687	360	− 90	239	−1,081	290
28	274	687	663	−197	237	−1,278	527
29	341	435	98	−133	− 16	−1,411	511
30	649	76	179	172	−377	−1,239	134
Decade departure						−1,135	−893
Deficiency since first of year	gr.-cal.					3,486	475
	per cent					9.6	1.4

TABLE 4.

Cloudiness (0—10)	0	1	2	3	4	5	6	7	8	9	10
	Gram-calories per minute per square centimeter.										
Equivalent of 0.1 inch on record sheet	0.0275	0.0275	0.0274	0.0273	0.0272	0.0272	0.0271	0.0271	0.0270	0.0270	0.0270

as the incident solar rays, so as to reduce to a minimum the effect of internal reflection from the glass cover of the receiver.[3] Under these conditions the value of a tenth of an inch on the record sheet, expressed in heat units, has been found to be 0.0270 gram-calory per minute per square centimeter, regardless of the zenith distance of the sun. This is practically the same value as was found at Mount Weather with the sun not more than 45° from the zenith. A correction has been applied to this value for blue-sky effect on account of the selective reflection and since the first of the year the deficiency has been 9.6 per cent. Madison shows an excess for the month of about 1.1 per cent and a deficiency since the first of the year of about 1.4 per cent, or departures from the normal that are quite insignificant.

[2] *See* the REVIEW for August, 1914, 42: 478.
[3] *See* the REVIEW for June, 1915, 43: 264–266.
[4] *See* the REVIEW for August, 1914, 42: 476–480.

CORRECTION.

In the REVIEW for March, 1916, 44:113, Table 2, in the headings in place of *Mm.* insert *Cm.*